Service Manual

Model

FW - 23 (A)

SPECIFICATIONS

Frequency Range
- Broadcast .....AM 530–1650 KC
  MB 1.6–4.3 MC
  SW 6–18 MC
  FM 86.5–108 MC
- Intermediate Frequency...AM 455 KC
  MB 455 KC
  SW 455 KC
  FM 10.7 MC

Transistor Complement
- Q1 2SA235(A) .....FM RF Amplifier
- Q2 2SA235(C) .....FM Converter
- Q3 2SA234(B) .....AM Mixer, FM IF Amplifier
- Q4 2SA234(B)/(C) .....AM Oscillator
- Q5 2SA234(B) .....AM FM IF Amplifier
- Q6 2SA234(B)/(C) .....AM FM IF Amplifier
- Q7 2SA234(A) .....FM IF Amplifier
- Q8 2SB75(B).....AF Amplifier
- Q9 2SB75(B).....Audio Driver
- Q10 2SA12C .....AFC
- Q11 2SB155(A).....Output
- Q12 2SB155(A).....Output
- Q13 2SB155(A).....Output
- Q14 2SB155(A).....Output
- Q15 2SA12C .....Color Indicator
- Q16 2SB77(B) .....Color Indicator
- Q17 2SB77(B) .....Color Indicator

Power Output
- Undistorted.....450 mW
- Maximum .....700 mW

Speaker .....5⅛″×3½″ PM 4 ohms @ 400 cycles

Power Supply .....6V (Use 4 size D batteries)

GENERAL DESCRIPTION

This portable has 17 transistors, 6 diodes and 2 thermistors.

A bar antenna feeds the AM, MB or SW broadcast signal to the converter.

After going through 2 IF amplifiers and 1 diode detector, the signal then passes through a 6 transistor audio amplifier circuit.

A rod antenna feeds the FM broadcast signal to the RF amplifier, 3 FM IF amplifiers and FM detector (2 diodes).

Audio signal then passes through a 6 transistor audio amplifier circuit.

An AM AGC voltage is fed back to 1st IF amplifier.

An AFC voltage is fed back to the FM converter.

CHASSIS REMOVAL

1. Remove battery compartment cover.
2. Remove battery holder.
3. Remove 2 cabinet back retaining screws and remove cabinet back.
4. Set dial pointer at low frequency end of dial.
5. Pull off the 4 control knobs located on the front of the cabinet.
6. Insert the tip of a narrow bladed screwdriver through the opening in the chassis and disengage the dial cord from the dial pointer.
7. Lift the Earphone/Ext. Power jack out of its slot in the side of the cabinet.
8. Remove the five chassis mounting screws and gently lift the chassis out of the cabinet.

HAYAKAWA ELECTRIC CO., LTD.

OSAKA, JAPAN

GENERAL ALIGNMENT INSTRUCTIONS

Should it become necessary at any time to check the alignment of this receiver, proceed as follows;

1) Connect an output meter across the speaker voice coil lugs.
2) Set volume control for maximum.
3) Use lowest setting of signal generator capable of producing adequate indication on the lowest scale of output meter.
4) Use a non-metallic alignment tool.
5) Repeat adjustments to insure good results.

FM ALIGNMENT CHART

Signal generator				Receiver		Adjust
Step	Band	Connect to receiver	Input signal frequency	Dial setting	Remarks	
1	F.M.	Connect signal generator through a 10KΩ dummy to converter emitter, test point 1, of Q2 ground lead to the receiver chassis.	Exactly 10.7MC. (400%, 30%, AM modulated)	Tuning gang fully closed. (maximum capacity)	Connect VTVM between TP4 and chassis ground.	Detune IFT4B. Tune, IFT4A, IFT3, IFT2 and IFT1 for maximum indication.
2	F.M.	Same as step 1.	Exactly 10.7 MC. (Unmodulated)	Same as step 1.	Same as step 1.	Tune IFT4B for null point (0 volt).
3	F.M.	Connect signal generator through a 100Ω, including output impedance of signal generator to the external antenna coil lug. Ground lead to the receiver chassis.	Exactly 86MC. (400%, 30%, FM modulated)	Tuning gang fully closed. (maximum capacity)	Adjust for maximum output speaker voice coil lugs.	L4
4	F.M.	Same as step 3.	Exactly 110 MC. (400%, 30%, FM modulated)	Tuning gang fully open. (minimum capacity)	Same as step 3.	C6
5	F.M.	Same as step 3.	Exactly 88MC. (400%, 30%, FM modulated)	88 MC.	Same as step 3.	L2
6	F.M.	Same as step 3.	Exactly 108 MC. (400%, 30%, FM modulated)	105 MC.	Same as step 3.	C5
7	F.M.	Repeat steps 3, 4, 5 and 6 until no further improvement is obtained.				

NOTE

(A) Check alignment of receiver antenna coil by bringing a piece of powdered iron (such as a coil slug) near the antenna loop stick, then a piece of brass. If powdered iron increases output, loop requires more inductance. If brass increases output, loop requires less inductance. Change loop inductance by sliding the bobbin toward the center of ferrite core to increase inductance, or away to decrease inductance. This adjustment should not be required unless L6 has been replaced.

(B) 1) Connect VTVM (0.1 volts range D.C. scale) across volume control of receiver. (Grounded terminal to high side of control.)
2) Adjust discriminator Sec. core for VTVM 0 volt.
3) Change signal generator frequency 10.7 MC+100 KC and −100 KC approximately.
4) Adjust discriminator Pri. core for balanced peaks. Peak separation should be approximately 200 KC.

AM, MB, SW ALIGNMENT CHART

Signal generator				Receiver		Adjust
Step	Band	Connection to receiver	Input signal frequency	Dial setting	Remarks	
1	A.M.	Connect signal generator through a 10 KΩ dummy to the antenna tuning condenser. Connect ground lead of generator to the receiver chassis.	Exactly 455 KC. (400%, 30%, AM modulated)	Tuning gang fully open. (minimum capacity)	Adjust for maximum output on speaker voice coil lugs.	IFT7 IFT6 IFT5
2	A.M.	Use radiating loop. Loop of several turns of wire, or place generator lead close to receiver for adequate signal pickup. Connect generator output to one end of radiating loop.	Exactly 520 KC. (400%, 30%, AM modulated)	Tuning gang fully closed. (maximum capacity)	Same as step 1.	L7
3	A.M.	Same as step 2.	Exactly 1680 KC. (400%, 30%, AM modulated)	Tuning gang fully open. (minimum capacity)	Same as step 1.	C9
4	A.M.	Same as step 2.	Exactly 600 KC. (400%, 30%, AM modulated)	600 KC	See NOTE A.	L6
5	A.M.	Same as step 2.	Exactly 1400 KC. (400%, 30%, AM modulated)	1400 KC	See NOTE A.	C7
6	A.M.	Repeat steps 2, 3, 4 and 5 until no further improvement is obtained.				
7	M.B.	Same as step 2.	Exactly 1.5MC. (400%,30%, AM modulated)	Tuning gang fully closed. (maximum capacity)	Same as step 1.	L8
8	M.B.	Same as step 2.	Exactly 4.5MC. (400%,30%, AM modulated)	Tuning gang fully closed. (maximum capacity)	Same as step 1.	C12
9	M.B.	Same as step 2.	Exactly 1.7MC. (400%,30%, AM modulated)	1.7 MC	See NOTE A.	L6
10	M.B.	Same as step 2.	Exactly 3.7MC. (400%,30%, AM modulated)	3.7 MC	See NOTE A.	C8
11	M.B.	Repeat steps 7, 8, 9 and 10 until no further improvement is obtained.				
12	S.W.	Same as step 2.	Exactly 5.85 MC. (400%, 30%, AM modulated)	Tuning gang fully closed. (maximum capacity)	Same as step 1.	L9
13	S.W.	Same as step 2.	Exactly 18.5 MC. (400%, 30%, AM modulated)	Tuning gang fully closed. (maximum capacity)	Same as step 1.	C11
14	S.W.	Same as step 2.	Exactly 6.5MC. (400%,30%, AM modulated)	6.5 MC	See NOTE A.	L6
15	S.W.	Same as step 2.	Exactly 16 MC.	16 MC	Same as step 1.	C10
16	S.W.	Repeat steps 12, 13, 14 and 15 until no further improvment is obtained.				

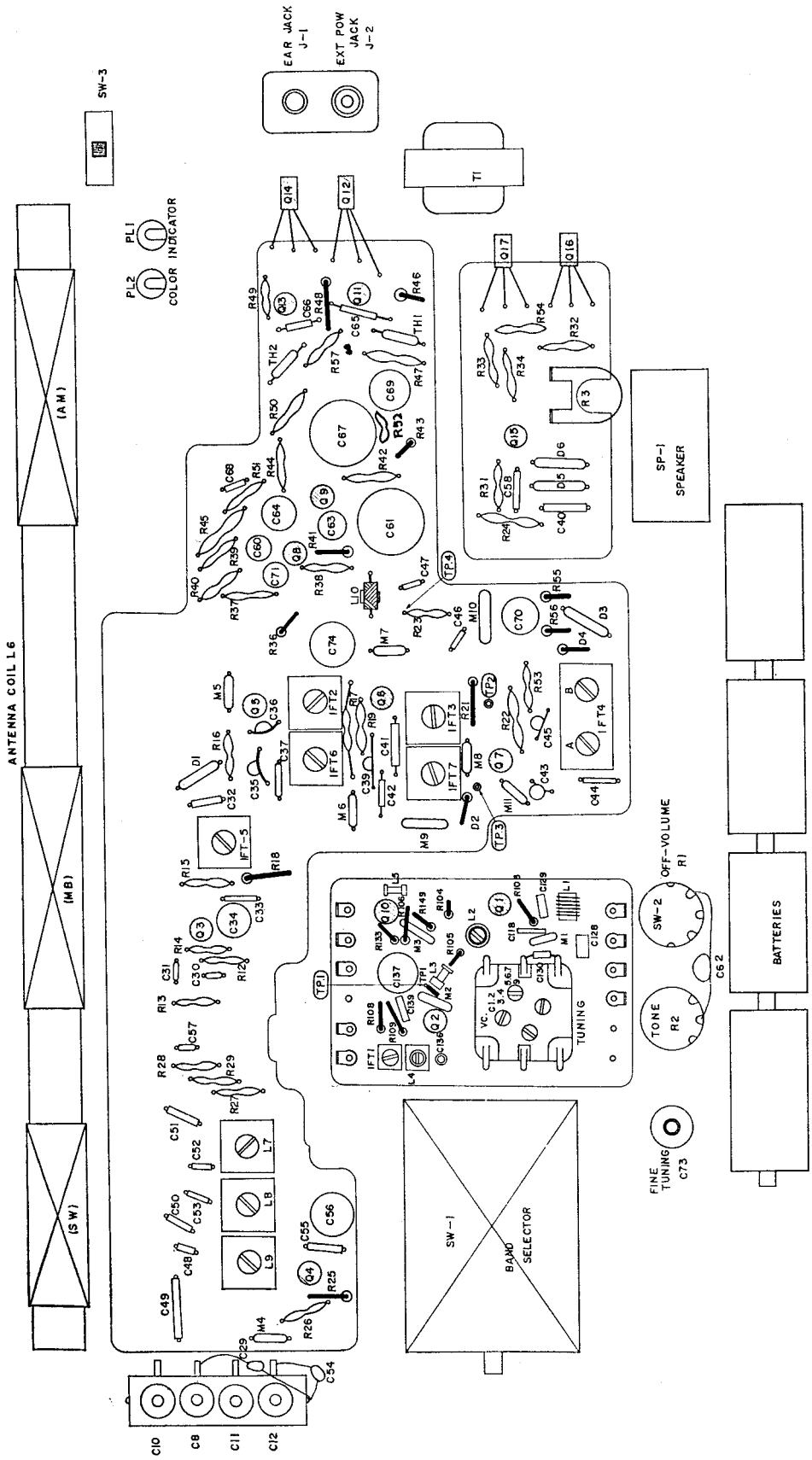


Figure 1 - Top View of Chassis

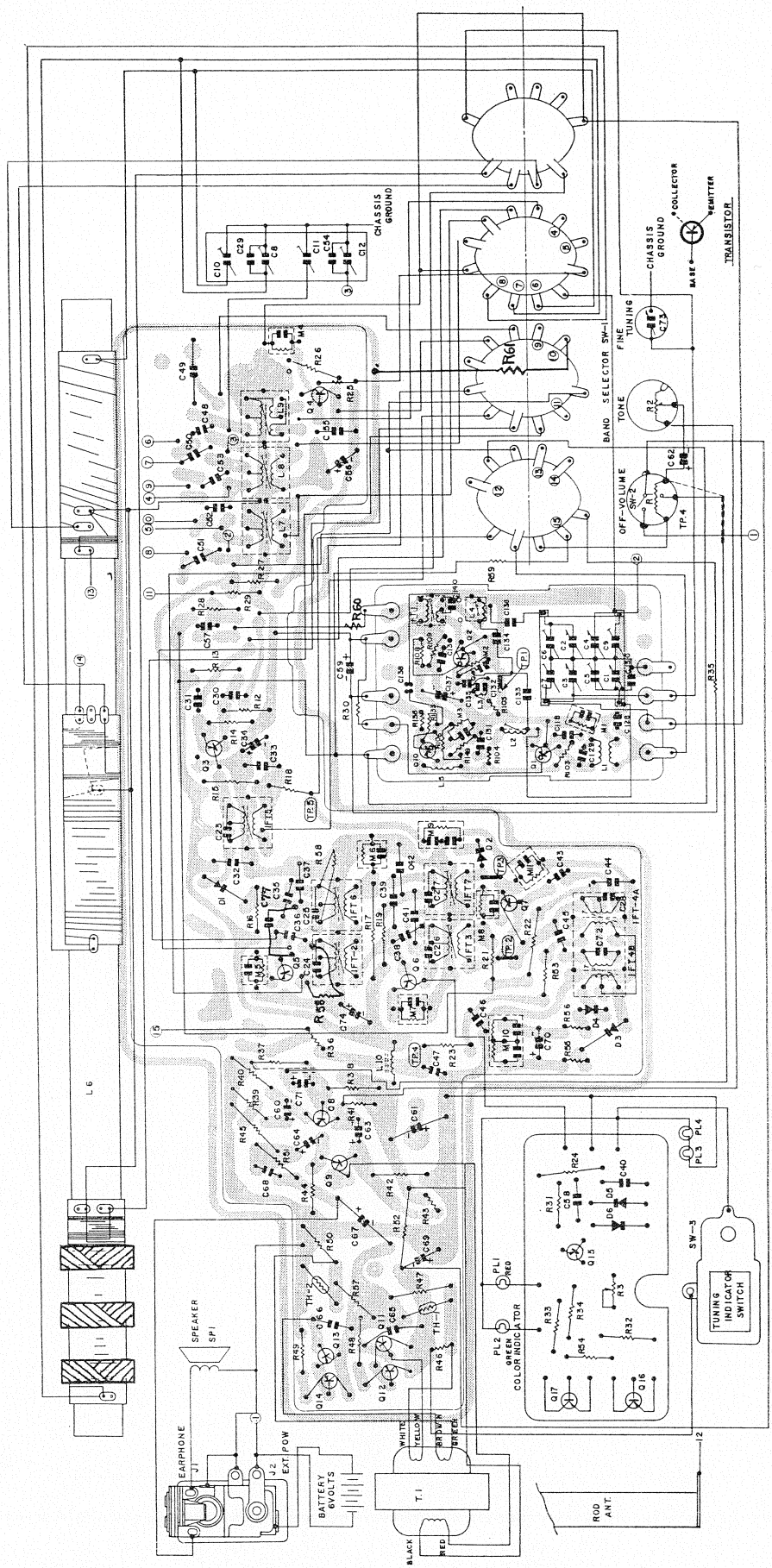
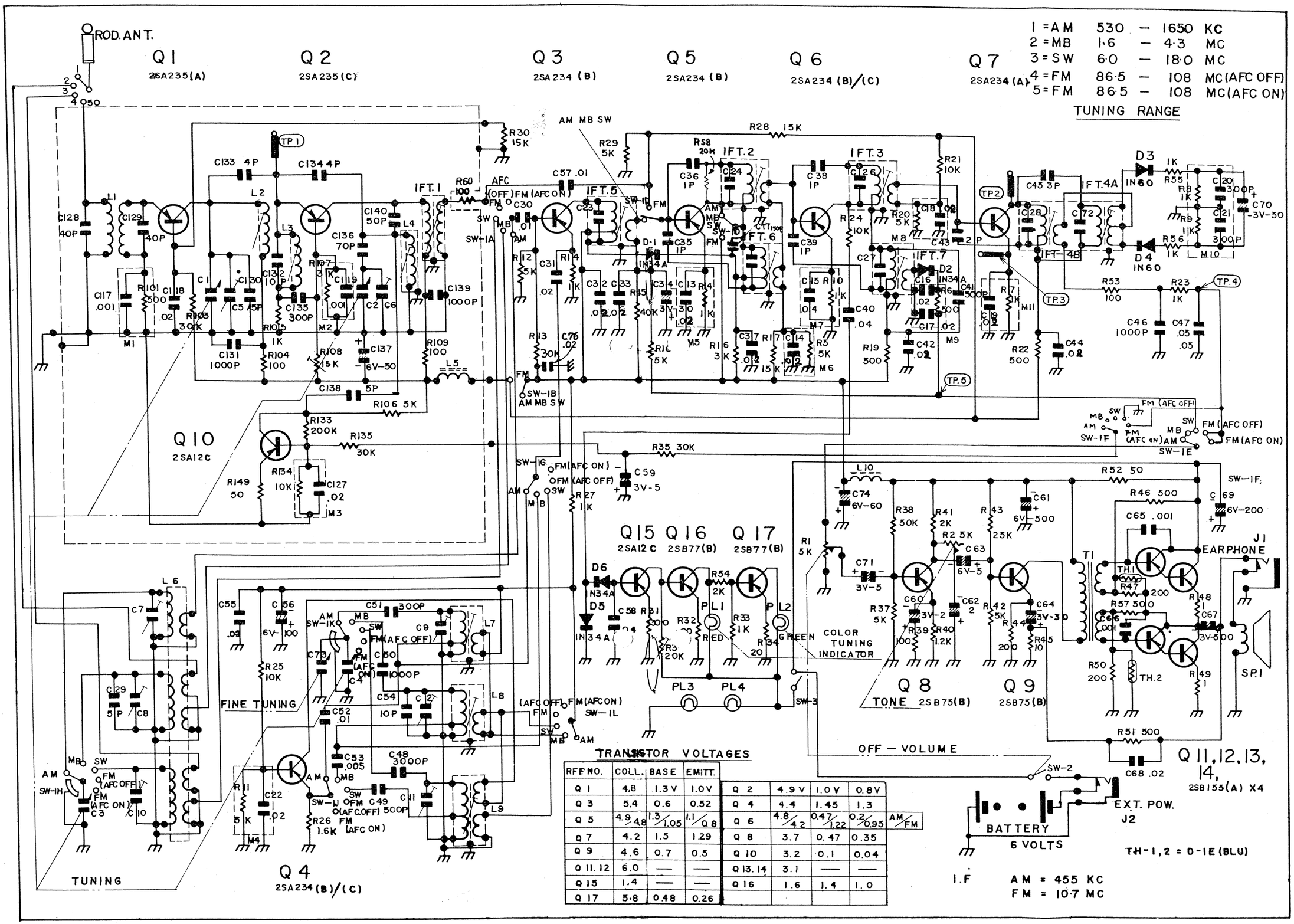


Figure 2 - Bottom View of PC Board



TRANSISTOR VOLTAGES

REF NO.	COLL.	BASE	EMITT.					
Q 1	4.8	1.3 V	1.0 V	Q 2	4.9 V	1.0 V	0.8 V	
Q 3	5.4	0.6	0.52	Q 4	4.4	1.45	1.3	
Q 5	4.9 / 4.8	1.3 / 1.05	1.1 / 0.8	Q 6	4.8 / 4.2	0.47 / 1.22	0.2 / 0.95	AM / FM
Q 7	4.2	1.5	1.29	Q 8	3.7	0.47	0.35	
Q 9	4.6	0.7	0.5	Q 10	3.2	0.1	0.04	
Q 11.12	6.0	—	—	Q 13.14	3.1	—	—	
Q 15	1.4	—	—	Q 16	1.6	1.4	1.0	
Q 17	5.8	0.48	0.26					

Figure 3 - Schematic Diagram

PARTS LIST

CAPACITORS

REF. NO.	PART NO.	DESCRIPTION
C_1,C_2,C_3,C_4, C_5,C_6,C_7,C_9	VC-318	Variable, Tuning
C_8, C_{10}, C_{11}, C_{12}	TO-824	Trimmer Assembly
C_{29}	D-5-509D	5 MMfd, 50V, Discap
C_{30},C_{52},C_{57}	ML-5-105M	.01 Mfd, 50V, 20%, Mylar
C_{31}, C_{68}	ML-5-205M	.02 Mfd, 50V, 20%, Mylar
C_{32},C_{33},C_{37}, C_{42},C_{44},C_{55}, C_{76}	D-2.5-205Z	.02 Mfd, 25V
C_{34}, C_{64}	DU-03-302X	30 Mfd, 3V, Electrolytic
C_{35},C_{36},C_{38}, C_{39}	D-5-109C	1 MMfd, 50V, Discap
C_{40}, C_{58}	K-3-405Z	.04 Mfd, 30V, Discap
C_{41}	T-5-507J	500 MMfd, 50V, Discap
C_{43}	D-5-209C	2 MMfd, 50V, Discap
C_{45}	D-5-309C	3 MMfd, 50V, Discap
C_{46}	D-5-106P	1000 MMfd, 50V, Discap
C_{47}	ML-5-505M	.05 Mfd, 50V, 20%, Mylar
C_{48}	S-5-306J	3000 MMfd, 50V, 5%, Styrol
C_{49}	S-5-507J	500 MMfd, 50V, 5%, Styrol
C_{50}	S-5-106J	1000 MMfd, 50V, 5%, Styrol
C_{51}	T-5-307J	300 MMfd, 50V, 5%, Discap
C_{53}	ML-5-506M	.005 Mfd, 50V, 20%, Mylar
C_{54}	D-5-108F	10 MMfd, 50V, Discap
C_{56}	CU-06-101X	100 MMfd, 6V, Electrolytic
C_{59}, C_{71}	CU-03-503X	5 Mfd, 3V, Electrolytic
C_{60}	CU-03-203X	2 Mfd, 3V, Electrolytic
C_{61}, C_{67}	CU-06-501X	500 Mfd, 6V, Electrolytic
C_{62}	K-TOK-CON	.2 Mfd, 6V, Electrolytic
C_{63}	CU-06-503X	5 Mfd, 6V, Electrolytic
C_{65}, C_{66}	ML-5-106M	.001 Mfd, 50V, 5%, Mylar
C_{69}	CU-06-201X	200 Mfd, 6V, Electrolytic
C_{70}	CU-03-502X	50 Mfd, 3V, Electrolytic
C_{73}	VC-903	Variable, Fine Tuning
C_{74}	CU-06-602X	60 Mfd, 6V, Electrolytic
C_{77}	T-5-157J	150 MMfd, 50V, 5%, Discap
C_{118}	K-3-205Z	.02 Mfd, 50V, Mylar
C_{128}, C_{129}	D-5-408J	40 MMfd, 50V, 10%, Discap
C_{130}, C_{138}	D-5-509D	5 MMfd, 50V, 10%, Discap
C_{131}, C_{139}	D-5-106P	.001 Mfd, 50V, 10%, Mylar
C_{132}	D-5-108D	10 MMfd, 50V, 5%, Discap
C_{133}, C_{134}	D-5-409D	4 MMfd, 50V, Discap
C_{135}	T-5-307J	300 MMfd, 50V, 5%, Discap
C_{136}	D-5-708J	70 MMfd, 50V, 5%, Discap
C_{137}	CU-06-502X	50 Mfd, 6V, Electrolytic
C_{140}	D-5-508J	50 MMfd, 50V, 5%, Discap

RESISTORS

REF. NO.	PART NO.	DESCRIPTION
R_1, SW-2	8V-748	5K ohm, Pot., Volume Control With Switch
R_2	8V-776	5K ohm, Pot., Tone Control
R_3	8V-775	20K ohm, Pot., Indicator Contol
R_{12},R_{18},R_{29}, R_{37}, R_{42}	1/4M-5KK	5K ohm, 1/4W, 10%, Carbon
R_{13}, R_{35}	1/4M-30KK	30K ohm, 1/4W, 10%, Carbon
R_{15}	1/4M-40KK	40K ohm, 1/4W, 10%, Carbon
R_{14},R_{23},R_{27}, R_{33},R_{55},R_{56}	1/4M-1KK	1K ohm, 1/4W, 10%, Carbon
R_{38}	1/4M-50KK	50K ohm, 1/4W, 10%, Carbon
R_{16}, R_{36}	1/4M-3KK	3K ohm, 1/4W, 10%, Carbon
R_{17},R_{28},R_{30}	1/4M-15KK	15K ohm, 1/4W, 10%, Carbon
R_{19},R_{22},R_{46}, R_{51}, R_{57}	1/4M-500K	500 ohm, 1/4,W, 5%, Carbon
R_{21},R_{24},R_{25}, R_{30}	1/4M-10KK	10K ohm, 1/4W, 10%, Carbon
R_{26}	1/4M-1.6KK	1.6K ohm, 1/4W, 10%, Carbon
R_{31}	1/4M-300K	300 ohm, 1/4W, 10%, Carbon
R_{32}, R_{34}	1/4M-20K	20 ohm, 1/4W, 10%, Carbon
R_{39},R_{53},R_{60}	1/4M-100K	100 ohm, 1/4W, 10%, Carbon
R_{40}	1/4M-1.2KK	1.2K ohm, 1/4W, 10%, Carbon
R_{41}, R_{54}	1/4M-2KK	2K ohm, 1/4W, 10%, Carbon
R_{43}	1/4M-25KK	25K ohm, 1/4W, 10%, Carbon
R_{44},R_{47},R_{50}	1/4M-200K	200 ohm 1/4W, 5%, Carbon
R_{45}	1/4M-10K	10 ohm, 1/4W, 10%, Carbon
R_{48}, R_{49}	1/2K-1K	1 ohm, 1/2W, 10%, Winding
R_{52}, R_{149}	1/4M-50K	50 ohm, 1/4W, 10%, Carbon
R_{58}	1/4M-20KK	20K ohm, 1/4W, 10%, Carbon
R_{59}	1/4M-100KK	100K ohm, 1/4W, 10%, Carbon
R_{61}	1/4M-2.2KK	2.2K ohm, 1/4W, 10%, Carbon
R_{103}, R_{135}	1/4M-30KK	30K ohm, 1/4W, 5%, Carbon
R_{104}, R_{109}	1/4M-100K	100 ohm, 1/4W, 10%, Carbon
R_{105}	1/4M-1KK	1K ohm, 1/4W, 5%, Carbon
R_{106}	1/4M-5KK	5K ohm, 1/4W, 10%, Carbon
R_{108}	8V-799	15K ohm, Semi-variable
R_{133}	1/4M-200KK	200K ohm, 1/4W, 10%, Carbon

PACKAGED CIRCUITS

M_1	PRC-325	C_{117}, R_{101}
M_2	PRC-344	C_{119}, R_{107}
M_3	PRC-343	C_{127}, R_{134}
M_4, M_6, M_8	PRC-315	C_{22}, R_{11} & C_{14}, R_5 & C_{18}, R_{20}
M_5, M_{11}	PRC-332	C_{13}, R_4 & C_{19}, R_7
M_7	PRC-306	C_{15}, R_{10}
M_9	PRC-303	C_{16}, C_{17}, R_6
M_{10}	PRC-333	C_{20}, C_{21}, R_8, R_9

SEMICONDUCTORS

Q_1	2SA-235(A)	Transistor, FM RF Amp.
Q_2	2SA-235(C)	Transistor, FM Conv.
Q_3	2SA-234(B)	Transistor, AM Mixer, FM IF Amp.
Q_4	2SA-234(B)(C)	Transistor, AM Osc.
Q_5	2SA-234(B)	Transistor, AM-FM IF Amp.
Q_6	2SA-234(B)	Transistor, AM-FM IF Amp.
Q_7	2SA-234(A)	Transistor, FM IF Amp.
Q_8, Q_9	2SB-75(B)	Transistor, AF Amp, and Drive.
Q_{10}	2SA-12C	Transistor, AFC
Q_{11}, Q_{12}, Q_{13}, Q_{14}	2SB-155(A)	Transistor, Audio Output (Matched Pair)
Q_{15}	2SA-12C	Transistor, Color Indicator

REF. NO.	PART NO.	DESCRIPTION
Q_{16}, Q_{17}	2SB-77	Transistor, Color Indicator
D_1,D_2,D_5,D_6	1N-34A	Diode,
D_3, D_4	1N-60	Diode, FM Detector (Matched Pair)
TH_1, TH_2	D-1E	Thermistor

TRANSFORMERS AND COILS

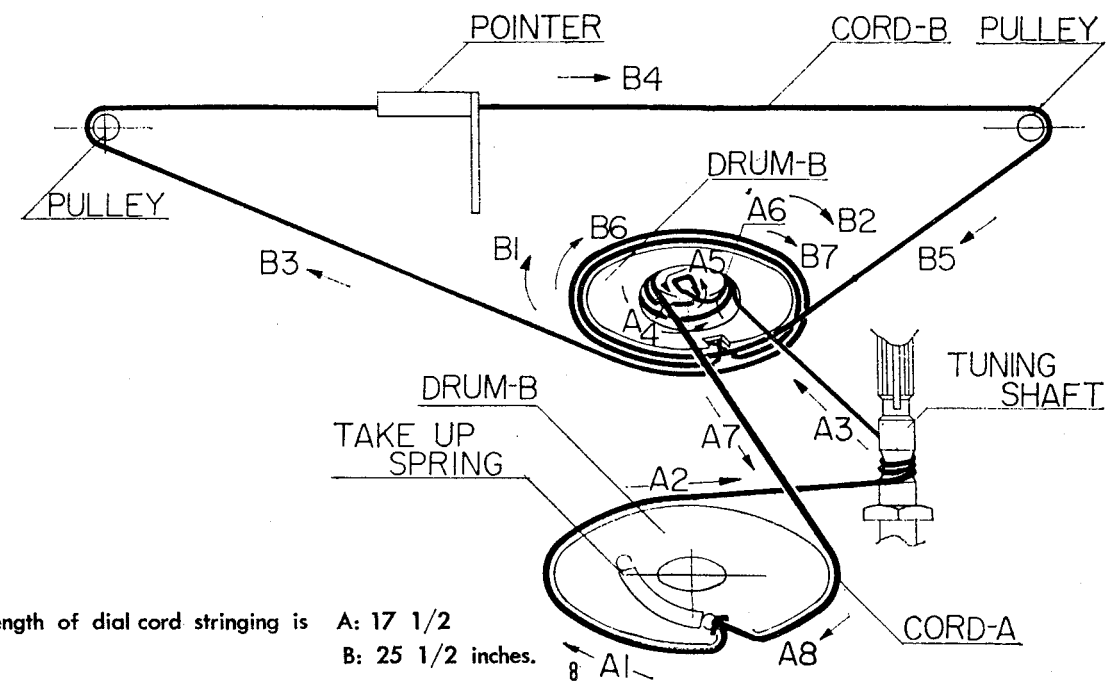
IFT_1	7IF-808	Transformer, 1st FM IF
IFT_2	7IF-767	Transformer, 2nd FM IF
IFT_3	7IF-767	Transformer, 3rd FM IF
IFT_4 A&B	7IF-739	Transformer, 4th FM IF
IFT_5	7IF-748	Transformer, 1st AM IF
IFT_6	7IF-765	Transformer, 2nd AM IF
IFT_7	7IF-734	Transformer, 3rd AM IF
T_1	6T-782	Transformer, Audio Input
L_1	7L-284A	Coil, FM Antenna
L_2	7L-573C	Coil, FM RF
L_3	7L-937	Coil, FM RF Choke
L_4	7L-057B	Coil, FM Oscillator
L_5	7L-911	Coil, FM Power Choke
L_6	7L-253A	Coil, AM, MB, SW Antenna
L_7	7L-392B	Coil, AM Oscillator
L_8	7L-462B	Coil, MB Oscillator
L_9	7L-452B	Coil, SW Oscillator

REF. NO.	PART NO.	DESCRIPTION

MISCELLANEOUS

	ROD-ANT-71	Antenna, Telscoping Rod
		Cabinet (Complete)
	DP-733	Drum, Dual Drive
	DP-732	Drum, Tuning
	MR-19	Earphone
	TOTTE-COVER-B	Handle, Bottom
	TOTTE-COVER-A	Handle, Top
	TOTTE-ANGL	Handle, Bracket (Metal)
	B-PIPE	Holder, Battery (Plastic)
	R-A-HOLD	Holder, Rod Antenna
J_1, J_2	J-931	Jack, Earphone/Ext. Power
	9K-234	Knob, Band Switch
	9K-188	Knob, Lamp Switch
	9K-181	Knob, Tuning
	9K-230	Knob, Volume, Tone and Fine Tuning
PL_3, PL_4	PL-520	Lamp, Dial
PL_1, PL_2	PL-511	Lamp, Indicator
		Pointer, Dial
SP_1	13J9P-15A	Speaker
		Spring, Battery
		Spring, Dial Cord (A)
		Spring, Dial Cord (B)
SW-1	2S-45	Switch, Band
SW-3	9S-63	Switch, Dial Lamp
	FMT-516	FM Front End Unit

DIAL CORD STRINGING



Overall length of dial cord stringing is A: 17 1/2
B: 25 1/2 inches.